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APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: Air Conditioning Apparatus With Blower And Electric
Heater In Common Housing

Air Conditioning Apparatus With Blower And Electric Heater In Common Housing

Description

5 Technical Field

This invention relates generally to air conditioning apparatus and in particular to air conditioning apparatus that includes an electric heater.

Background Art

The indoor unit of an air conditioning system, which often is referred to as an
10 air handler, typically includes a cabinet having at least a filter section, a heat
exchanger section and a blower section. In electrically powered heating/cooling
systems, such as heat pumps, the air handler usually also includes an electric heating
section having one or more electric heating elements. The heating section is usually
located downstream of the blower section in relation to the direction of air flow in
15 the cabinet. One such air handler is shown and described in U.S. Patent 3,977,467.

In operation, air to be cooled or heated is drawn into the cabinet through a
return air duct and is first passed through a filter in the filter section to remove dirt
and other debris. After the air passes through the filter, it flows across a heat
exchanger coil in the heat exchanger section, which communicates with the suction
20 side of an air blower in the blower section. The blower then discharges the air
through the electric heating section into a supply duct that communicates with an
indoor space. When the heating/cooling system (e.g., a heat pump system) is operated
in a cooling mode and a vapor compression refrigerant is used as the heat transfer
fluid, the heat exchanger coil functions as an evaporator to cool the air that flows
25 through the heat exchanger section by vaporization of the refrigerant in the heat
exchanger tubes. When the system is operated in a heating mode, the heat exchanger
coil functions as a condenser to heat the air by condensation of the refrigerant. The
electric heating elements are typically used at the beginning of a heating cycle and

may also be used during the heating cycle to supplement the heating provided by the heat exchanger coil.

It is also known in the art to provide an elongated electrically resistive heating element in the blower section. Such heating element is permanently affixed in the blower section and is at least partially wrapped around the blower. Although this configuration eliminates the need for a dedicated electric heating section downstream of the blower section, the heating element is not field-replaceable to accommodate different electrical heating capacities.

10 Summary of the Invention

In accordance with the present invention, air conditioning apparatus is provided in which an air blower and an electric heating assembly are located in a common housing and the heating assembly is removably mounted with the housing. This configuration eliminates the need for a dedicated section in the apparatus for the electric heater downstream of the blower section, which reduces the size of the apparatus. Further, the removability feature facilitates replacement of the heater assembly in the field if a different capacity heater assembly is desired or in the event of a component malfunction.

In accordance with one aspect of the invention, the heater assembly is removably mounted with a wall of the housing, such that the heater assembly projects into the housing in transverse relationship to the blower with respect to the general direction of air flow in the housing. In accordance with another aspect of the invention, the heater assembly is comprised of at least one heating element having a major dimension that is generally parallel to the direction of air flow.

In accordance with one embodiment of the invention, the heating element has at least one insulator extending between adjacent portions of the element. The insulator has a major surface and a minor surface, with the major surface being oriented generally parallel to the direction of air flow so as not to restrict air flow.

In accordance with another embodiment of the invention, the blower housing has an open mouth through which air is dischargeable by the blower, a relatively flat portion and a curved portion. The heater assembly projects into the housing from the relatively flat portion. The heater assembly includes a relatively flat mounting
5 plate and is insertable into the blower housing through an opening in the relatively flat portion. The plate is mounted with the housing to close off the opening and defines at least a part of the relatively flat portion.

In accordance with still another embodiment of the invention, the electrical heater is comprised of plural electrically resistive heating elements in an open coil
10 configuration. Each element is comprised of a generally U-shaped coil that follows the general contour of the blower housing adjacent the coil. A major dimension of the coil is parallel to the general direction of air flow in the blower housing.

Brief Description of Drawings

15 FIG. 1 is a perspective view of a blower housing containing an air blower and electrical heating elements, according to the present invention;

FIG. 2 is a top plan view of the blower housing of FIG. 1;

FIG. 3 is a side elevation view of the blower housing of FIG. 1, with a portion of the housing cut away to show an electrical heating element;

20 FIG. 4 is a right side elevation view of an air conditioning unit according to the present invention;

FIG. 5 is a right side elevation view of a prior art air conditioning unit;

FIG. 6 is a front elevation view of the air conditioning unit of FIG. 4;

FIG. 7 is a front elevation view of the air conditioning unit of FIG. 5;

25 FIG. 8 is a perspective view of the air conditioning unit of FIG. 4;

FIG. 9 is a perspective view of the air conditioning unit of FIG. 5; and

FIG. 10 is a front elevation view of an electrical heating element according to the present invention.

Best Mode for Carrying Out the Invention

The best mode for carrying out the invention will now be described with reference to the accompanying drawings. Like parts are marked in the specification and drawings with the same respective reference numbers. In some instances, 5 proportions may have been exaggerated in order to depict certain features of the invention.

Referring now to FIGS 5, 7 and 9, a conventional air handling unit **10** used in an electrically powered heating/cooling system, such as a heat pump system, is depicted in an upright position for "upflow" operation. Unit **10** includes a cabinet **11**, 10 which houses, from bottom to top, a filter section **12**, a heat exchanger section **14**, a blower section **16** and an electrical heating section **18**. In operation, air to be cooled or heated is drawn into cabinet **11** by an air blower **17** in blower section **16** through a return air duct **19** in communication with the lower front portion of cabinet **11**, as indicated by directional arrows **20** in FIGS. 5 and 9, and is first passed through a 15 filter **21** in filter section **12** to remove dirt and other debris, as indicated by directional arrows **23** in FIG. 5. After the air passes through filter section **12**, it is drawn upwardly by blower **17** through a heat exchanger coil **22** in heat exchanger section **14** into blower section **16** and is then discharged through electrical heating section **18** into a discharge conduit **24**, as indicated by directional arrows **25** in FIGS 20 5 and 9. Heat exchanger **22** is shown as a conventional tube and fin heat exchanger of the "A-coil" type. A drain pan **27** is located beneath coil **22** to capture condensate runoff therefrom.

When unit **10** is operated in a cooling mode, heat exchanger coil **22** is operative to transfer heat from the air to the heat transfer medium inside the tubes 25 (e.g., by evaporation of the refrigerant when a vapor compression refrigerant is used as the heat transfer medium). Electrical heating section **18** includes plural electrical heating elements **26** in an open coil configuration. Heating elements **26** are

inoperative in the cooling mode. When unit **10** is operated in a heating mode, coil **22** transfers heat from the heat transfer medium to the air (e.g., by condensation of the refrigerant when a vapor compression refrigerant is used as the heat transfer medium). Heat exchanger section **14** communicates with the suction side of blower **17**. Blower **17** draws air upwardly through heat exchanger **22** and discharges the air into electric heating section **18**, wherein the air is heated by electrical heating elements **26** when elements **26** are operative (i.e., typically at the beginning of a heating cycle or whenever supplemental heating is needed). Supply duct **24** communicates between the top portion of cabinet **11** and an indoor space (not shown).

The longitudinal or major axis of each heating element **26** is generally perpendicular to the direction in which air is discharged by blower **17** through heating section **18**. Blower **17** is contained in a housing **28** that includes a relatively flat portion **28a** and a curved portion **28b**, as can be best seen in FIG. 5. Housing **28** is inserted into cabinet **11** through an opening in the front thereof, which is provided by removing a front panel (not shown) of cabinet **11**, such that relatively flat portion **28a** is inserted first and faces the closed back portion of cabinet **11**, with curved portion **28b** facing toward the front.

Referring now to FIGS 4, 6 and 8, an air handling unit **30** according to the present invention is also depicted in an upright position for "upflow" operation. Unit **30** has essentially the same configuration as the prior art unit **10** described hereinabove with reference to FIGS 5, 7 and 9, except that unit **30** does not have a dedicated electric heating section downstream of the blower section **34**. Instead, a heater assembly comprised of plural heating elements **32** and an air blower **36** are both located in a housing **38** in blower section **34**. The heater assembly is located in housing **38** in transverse relationship to blower **36** with respect to the general vertical direction of air flow in cabinet **40** of unit **30**, as indicated by directional arrows **23** and **25** in FIG. 5.

Referring also to FIGS 1-3, blower **36** is preferably a blower of the centrifugal "squirrel cage" type for discharging air radially outwardly by rotation of blower blades **36a**. Housing **38** has an open mouth **38a** through which air is dischargeable from housing **38**. The wall of housing **38** includes a relatively flat portion **38b** and
5 a curved portion **38c**. The heater assembly projects into blower housing **38** from relatively flat portion **38b**. Heating elements **32** are preferably mounted on a relatively flat plate **42** and are insertable into housing **38** through an opening or cutout (not shown) in relatively flat portion **38b**. Plate **42** is removably mounted with relatively flat portion **38b** to close off the opening or cutout in relatively flat portion
10 **38b**, such that plate **42** defines at least a part of relatively flat portion **38b**. By removably mounting the heater assembly with blower housing **38**, the heater assembly is replaceable in the field if a different capacity heater assembly is desired or in the event of a component malfunction.

To facilitate access to the heater assembly, housing **38** is inserted into cabinet
15 **40** of unit **30** through the open front thereof by inserting curved portion **38c** first, such that relatively flat portion **38b** faces the open front of cabinet **40**. Flanges **43** on opposed sides of housing **38** facilitate the insertion of housing **38** into cabinet **40** and the mounting of housing **38** with respect to cabinet **40**. One skilled in the art will recognize that housing **38** is oriented in the opposite direction from housing **28** in
20 the prior art unit **10** described hereinabove with reference to FIGS 5, 7 and 9, as can be best seen by comparing FIGS 4 and 5.

The heater assembly shown in FIGS 1-4, 6 and 8 is comprised of two distinct heating elements **32**, each having an electrically resistive heating coil **44** in an open coil configuration. However, one skilled in the art will recognize that the heater
25 assembly may have more or fewer than two distinct heating elements **32**. Referring also to FIG. 10, each heating coil **44** is oriented vertically, such that its major dimension is generally parallel to the direction of air flow in housing **38**. Further, each coil **44** is generally U-shaped, as can be best seen in FIG. 10, and is comprised of two parallel legs **44a** extending along the major dimension of coil **44** with a

curved portion **44b** connecting legs **44a**. As can be best seen in FIG. 3, each leg **44a** has a relatively straight upper portion and a slightly inwardly curved lower portion, such that each leg **44a** follows the contour of the portion of the wall of housing **38** adjacent to coil **44**. Specifically, the upper portion of each leg **44a** is generally parallel to relatively flat portion **38b** and the lower portion of each leg **44a** is generally parallel to curved portion **38b**. Ceramic insulators **46** are interposed between the legs **44a** of each coil **44** to insulate coils **44** from the metal mounting members **48** used to mount coils **44** in relatively fixed positions within housing **38**. Insulators **46** are relatively flat and are oriented with their respective major faces parallel to the major dimensions of the corresponding coil **44**.

In operation, blower **36** blows air transversely outwardly toward the bottom of coils **44** and upwardly therethrough, whereby the air is heated. By orienting coils **44** so that their respective major dimensions are generally parallel to the air flow, the air is heated along the entire length of each coil **44** to enhance heating efficiency. Further, by orienting coils **44** and insulators **46** parallel to the air flow, the air flow is not substantially restricted by these components. For example, in an air handler for a 3-ton air conditioning system having 1200 cubic feet per minute air flow capacity, each coil **44** may have a length along its major dimension of about 12 inches, with the relatively straight upper portion of each leg **44a** comprising about five inches of the overall 12 inch length. Each coil **44** may be comprised of 16 or 18 gage wire in a spiral wound configuration, with a diameter of about 0.675 inch.

By eliminating a dedicated electric heating section from the air handler cabinet in accordance with the present invention, the size of the air handler may be reduced by as much as 10 inches in comparison to prior art air handlers of similar capacities. This size reduction allows an air handler unit according to the present invention to be installed in more restricted spaces than would otherwise be possible and reduces the cost of the air handler.

The best mode for carrying out the invention has now been described in detail. Since changes in and additions to the above-described best mode can be made

without departing from the nature, spirit and scope of the invention, the invention is not to be limited to the above-described best mode, but only by the appended claims and their equivalents.